16.

Parasites of Fish in the Upper Snake River Drainage and in Yellowstone Lake, Wyoming.

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During July and part of August in the seasons of 1949 and 1950 a study was made of fish parasites in the Jackson Hole area and in Yellowstone Lake, Wyoming. This survey was supported in part by grants from the New York Zoological Society and the collecting and preliminary identifications were done at the Jackson Hole Research Station of the New York Zoological Society.

In the two periods 2,535 fish belonging to 14 different species were examined and 2,351 or 92.3 per cent. carried at least one species of parasite. Many of these fish were obtained by seining. Assisting in collecting were members of the laboratory group for the two seasons. Special acknowledgment for aid is given to Dr. N. A. Meinkoth, Mr. Harold Hagen, Mr. James R. Simon and to my daughter Jean. Fishermen and the guides and boatmen at Jackson Lake docks assisted in collecting the game species. The specimens from Yellowstone Lake were obtained through the cooperation of the fish hatchery superintendent at Lake Station, and the creel census workers and Dr. Oliver B. Cope of the U. S. Fish and Wildlife Service.

Most of the fish were examined while fresh with the aid of a dissecting microscope. After the external parts, eyes and gills had been examined, the viscera were searched for encysted and internal parasites, then the viscera and contents were placed in a container with an approximately 0.7 per cent. solution of sodium bicarbonate and shaken vigorously.

Then the viscera were removed, the solution poured off and the concentrated parasites picked out from a petri dish under the binocular microscope. For a portion of the Yellowstone Lake cutthroat trout and for all of the Jackson Lake mackinaw trout, only the viscera, pectoral fins and gills were available for examination. Acanthocephala were allowed to die in water before being preserved. All parasites were preserved in 5 per cent. formalin after the larger forms had been killed in hot 10 per cent. formalin. The parasites were stained in Delafield's haematoxylin and mounted for study. After preliminary study and tentative identification, the acanthocephalan forms were submitted to Dr. H. J. Van Cleave, the parasitic copepods to Dr. William Tidd and the gill flukes to Dr. J. D. Mizelle. All of the identifications in the present report are those of the author except for one identification of a leech by Dr. Marvin C. Meyer.

The small number of fish species obtained and the fact that there were not many different types of habitats limited the numbers of various parasite species to less than that taken in previous surveys by the writer: northern Wisconsin (1946), Algonquin Park Lakes (1941a; 1946), southern Florida (1941b) and Reelfoot Lake (1942).

The table below lists the forms frequently encountered in several different fish species. An asterisk in front of the name indicates a larval encysted stage.

TABLE I.
Parasites Frequently Encountered.

	Number of species of fish
Trematoda	
Allocreadium lobatum	8
**Posthodiplostomum minimum*	7
Crepidostomum farionis	6
Gyrodactyloidae	6
**Diplostomum* sp.	5
**Neascus* sp.	4
**Clinostomum marginatum*	4
Cestoda	
**Diphyllobothrium* spp.	4
**Ligula intestinalis*	3
Proteocephalus laruei	2
Nematoda	
**Contracaecum spiculigerum*	6
Rhabdochona sp.	6
Bulbodacnitis scotti	4
**Bulbodacnitis scotti*	4
Metabronema salvelini	4
**Philonema agubernaculum*	3
Hepaticola bakeri	3
Capillaria catenata	2
Acanthocephala	
Neoechinorhynchus spp.	5
Copepoda	
Ergasilus sp.	4
Salmincola sp.	2
Protozoa	
**Ichthyophthirius multifiliis*	4
*Myxosporidia	2

Strigeid metacercariae were found to be widely distributed in the minnows and dace but were infrequently taken from suckers,

trout and whitefish. *P. minimum* was found to be encysted in a majority of hosts including plains longnose dace, Bonneville spring dace, Utah chub and Utah silverside minnow. All of 86 northern suckers from Pelican Creek, near Yellowstone Lake, had eye flukes *Diplostomum* sp. The same or a related species of *Diplostomum* was found in a smaller number of hosts in four other fish species. *Ligula intestinalis* was found in 19 of 73 chubs taken in 1950 from Emma Matilda Lake. It was taken from relatively few chubs and suckers from other areas. The Utah chubs from Two Ocean Lake showed a higher infection with the yellow grub, *Clinostomum marginatum*, and with the protozoan *Ichthyophthirius multifiliis* than chubs from 15 other areas.

The Utah chub yielded the greatest number of different parasite species, 25 being taken from 670 hosts in 15 locations in the two seasons. At one time during 1950 many chubs were lost as a result of a mixed infection of *I. multifiliis* and gyrodactylid flukes.

Young rosyside suckers, Utah chubs, Utah silverside minnows and Bonneville spring dace from Jackson Lake showed lighter infections than the same host species from many other areas. This may have been due to frequent changes in water levels and consequent interruptions in life cycles of the parasites.

A number of interesting parasite infections were encountered among the species of trout from different areas but these will be reported on in the discussion of distribution of parasites by species of fish, which follows.

The species of fish are arranged according to J. R. Simon (1946), "Wyoming Fishes." The species of parasites are listed in order of frequency of occurrence. The number following each name indicates the number of fish which harbor the parasite. Encysted larval forms are indicated by a single asterisk (*) while immature stages within the digestive tract are marked by a double asterisk (**).

1. Rocky Mountain Whitefish.

Prosopium williamsoni williamsoni (Girard).

(Examined 23; infected 23).

Proteocephalus laruei	17
Allocreadium lobatum	8
Gyrodactyloidae	7
**Philonema agubernaculum*	5
Achtheres coregoni	4
Crepidostomum farionis	3
Metabronema salvelini	1
Bulbodacnitis scotti	1
**Diplostomum* sp.	1

All of the hosts were secured from Whiteman Creek or the Snake River near Moran, Wyoming, by hook and line. Most specimens of the cestode *P. laruei* were immature. The nematode *P. agubernaculum* was taken from cysts in the mesentery or near the liver surface. As many as 7 were secured from a single host. This species was described by Simon & Simon (1936) from Wyoming *Prosopium williamsoni*, *Salvelinus fontinalis* and *Salmo shasta*.

2. Yellowstone Cutthroat Trout.

Salmo clarkii lewisi (Girard).

(Examined 291; infected 278).

Crepidostomum farionis	207
Bulbodacnitis scotti	149
**Diphyllobothrium* spp.	119
Salmincola sp.	50
Metabronema salvelini	39
Allocreadium lobatum	31
**Bulbodacnitis scotti*	26
Glochidia (*Margaretifera margaretifera*)	8
**Posthodiplostomum minimum*	3
Myxosporidia (gills)	2
***Proteocephalus laruei*	2
**Agamospiura* sp.	2
**Apophallus* sp.	1
Gyrodactyloidae	1
Hepaticola bakeri	1
Illinobdella sp.	1

Adult hosts were examined from Yellowstone Lake, Snake River, Lake Solitude, Two Ocean Lake, Flat Creek, Game Creek and young individuals from Polecat and Glade Creeks. The 135 cutthroat trout from Yellowstone Lake were obtained from those dead or injured at the traps in Pelican Creek and from viscera and gills preserved by the creel census workers at Fishing Bridge and the boat docks at West Thumb.

All of 53 hosts from the Fishing Bridge and Pelican Creek area were parasitized. The following lists gives the number of hosts parasitized. The degree of the infections was light to moderate.

B. scotti (53)
C. farionis (49)
Myxosporidia (gills) (1)
**B. scotti* (5)
**Diphyllobothrium* spp. (47)
Salmincola sp. (8)

From the West Thumb portion of the lake the following findings were obtained in 82 hosts:

B. scotti (82)
C. farionis (71)
Illinobdella sp. (1)
Salmincola sp. (40)
**B. scotti* (12)
Diphyllobothrium spp. (71)
*Myxosporidia (1)

The nematode *B. scotti*, found free in the intestine of all these hosts and encysted in large, round cysts in 17, was a species described by Simon (1935) for the same host from Yellowstone Lake. Thirteen cutthroat trout from Game Creek, below Jackson, yielded 12 with intestinal nematodes, *B. scotti*, while 9 of the same hosts carried numerous large membrane-covered cysts of this species on the liver or in the mesenteries about the intestines. The original stock had come from the Yellowstone Lake Hatchery. Only 8 cutthroat out of the 139 infected hosts from other areas yielded this nematode.

Cysts of *Diphyllobothrium* spp. were with one exception all from Yellowstone Lake

hosts. They were of more than one type. Scott (1935) says that the plerocercoids are of three or possibly four types. Almost all of the cysts found were in the mesentery cysts or in the muscle wall of the stomach or intestine. There were very few forms in the flesh. However in a majority of these hosts it was not possible to examine the flesh. There were at least two or three quite different types of plerocercoids recovered from the cysts.

The parasitic copepod *Salmincola* sp. resembled *S. edwardsi* in general characteristics but was found in a different position on the hosts and it was not taken from its usual host in Wisconsin (unpublished data). In the Wisconsin hosts only brook trout were infected and then damage to the gills and operculum was often marked. In the infections with the *Salmincola* for the hosts being discussed in this report, most were found attached inside the pectoral fin. A few were fastened to the gill bars. All but two of the hosts with *Salmincola* sp. were from Yellowstone Lake.

C. farionis was the fluke obtained from nearly all of the hosts except those from Lake Solitude, a small glacier-fed lake at an elevation of 9,020 feet. Cutthroat trout had been planted here by individuals who carried up the cans of young hatchery fish. In 1949 all of 15 trout bore only *A. lobatum* and in 1950 only 16 of 26 from Lake Solitude were infected with this fluke. All were adult and the infection must have been brought in when the fish were planted. Cascade Creek drains from Lake Solitude. Four brook trout were examined from this small mountain stream and two bore *A. lobatum*. All also had adults of another trematode, *C. farionis*. Out of those examined, only one other trout, a cutthroat from Snake River, bore *A. lobatum*.

Another localized infection was that of the young cutthroat trout examined from Polecat Creek, a stream flowing into the Snake River just south of Yellowstone Park. In 1949 glochidia were found as gill cysts on 8 of 10 fingerling trout and in 1950 the two young cutthroat trout that were examined also bore similar glochidia. The only clam in the stream is *Margaretifera margaretifera*. *M. salvelini* was found in the stomach and upper intestine of several hosts from Snake River, Two Ocean Lake and Polecat Creek. The form described by Chandler (1931) was first assigned to the genus *Cystidicola* but afterwards was transferred by Skinker (1931) to the genus *Cystidicoloides*. The species parasitic in trout have been re-examined by Chouquette (1948) and on the basis of the characters of the postcloacal papillae and the spicules, the following species should be regarded as synonymous:

Metabronema (= *Spiroptera*) *salvelini* Fudita (1920)
Metabronema harwoodi Chandler (1931)
Metabronema canadense Skinker (1931)
Metabronema truttae Bayliss (1935)

3. Brook Trout.
Salvelinus fontinalis fontinalis (Mitchill).
(Examined 140; infected 108).

Crepidostomum farionis	105
**Diphyllobothrium* sp.	4
Metabronema salvelini	4
Allocreadium lobatum	2
**Contracaecum spiculigerum*	1
Bulbodacnitis scotti	1

The hosts infected with *Diphyllobothrium* sp., *C. spiculigerum* and *B. scotti* all came from the Lewis River in the Yellowstone Park. Nine of the 10 brook trout from here carried *C. farionis* and one *M. salvelini*. The parasitism of the brook trout from Cascade Creek was already mentioned. In the trout examined from five other locations, three had *M. salvelini* and 94 of 120 had intestinal flukes, *C. farionis*.

4. Brown Trout.
Salmo trutta fario Linnaeus.
(Examined 4; infected 4).

Crepidostomum farionis	3
**Bulbodacnitis scotti*	1
**Philonema agubernaculum*	1

Three of the hosts came from Jackson Lake and one from the Snake River.

5. Rainbow Trout.
Salmo gairdneri irideus Gibbons.
(Examined 1; infected 1).

Crepidostomum farionis	1

The single host was taken by hook and line at Sublette Lake.

6. Mackinaw Trout, Lake Trout.
Cristivomer namaycush namaycush (Walbaum).
(Examined 184; infected 175).

Bulbodacnitis scotti	145
Crepidostomum farionis	56
Metabronema salvelini	6
Neoechinorhynchus sp.	4
Salmincola sp.	2
**Diphyllobothrium* sp.	2
Eubothrium salvelini	2
Hepaticola bakeri	2
**Philonema agubernaculum*	1
Cystidicola stigmatura	1
Nephelopsis obscura	1

All of these hosts came from Jackson Lake. The degree of infection in the hosts was relatively light, with very few encysted forms. One unusual case of parasitism was that of the leech, *N. obscura*, found within the air bladder of an adult mackinaw trout.

7. Mountain Sucker.
Pantosteus jordani Evermann.
(Examined 22; infected 0).

These fish came from beaver ponds near Jackson Lake Lodge and from Pacific Creek.

8. Rosyside Sucker.
Catostomus fecundus Cope & Yarrow.

(Examined 227; infected 182).

**Neascus* sp.	80
Gyrodactyloidae	56
Caryophyllaeus tetebrans	38
**Diplostomum flexicaudum*	28
Neoechinorhynchus sp.	25
**Posthodiplostomum minimum*	12
**Contracaecum spiculigerum*	11
**Ichthyophthirius multifiliis*	8
*Myxosporidia	8
**Clinostomum marginatum*	5
**Ligula intestinalis*	3
Rhabdochona sp.	2
**Tetracotyle* sp.	2
Ergasilus sp.	1
Allocreadium lobatum	1
Actinobdella triannulata	1
Pomphorhynchus bulbocolli	1
Triganodistomum sp.	1

All of 38 adult hosts were parasitized. Most of these fish came from the Snake River. The fingerlings came from 9 different locations in Jackson Lake, Polecat Creek, Pacific Creek, String Lake, Glade Creek and other streams near Moran. Most of the encysted parasites were secured from the young hosts. Thirty-six adults from the Snake River, taken in 1949 and 1950, had the following numbers infected with the parasites listed: *C. tetebrans* (35), **C. spiculigerum* (3), **D. flexicaudum* (26), *Myxosporidia (2), *Neoechinorhynchus* sp. (18), *P. bulbocolli* (1), *Rhabdochona* sp. (1).

9. Northern Sucker, Eastern Longnose Sucker.
Catostomus catostomus catostomus (Forster).

(Examined 86; infected 86).

**Diplostomum flexicaudum*	86
***Rhabdochona* sp.	7
**Bulbodacnitis scotti*	4
**Ligula intestinalis*	1
**Posthodiplostomum minimum*	1

All of these northern suckers were taken from traps in Pelican Creek where the sucker runs to spawn at the same time as the cutthroat trout. Park authorities believe that these suckers may have been introduced by fishermen who employed them for bait (Simon, 1939). The fact that so few hosts were parasitized, except for the presence of the eye flukes, and that there were no adult intestinal forms, would indicate these fish were not native to Yellowstone Lake.

10. Plains Longnose Dace.
Rhinichthys cataractae ocella Garman.

(Examined 27; infected 27).

**Posthodiplostomum minimum*	26
**Neascus* sp.	11
Rhabdochona cascadilla	9
Gyrodactyloidae	3
**Contracaecum spiculigerum*	2
Allocreadium lobatum	1

The hosts came from five streams in the Jackson Hole area.

11. Bonneville Spring Dace.
Rhinichthys osculus carringtonii (Cope).

(Examined 343; infected 341).

**Posthodiplostomum minimum*	313
**Neascus* sp.	67
Rhabdochona cascadilla	29
Gyrodactyloidae	15
Hepaticola bakeri	11
**Eustrongylides* sp.	11
**Ichthyophthirius multifiliis*	10
**Contracaecum spiculigerum*	3
**Clinostomum marginatum*	2
Allocreadium lobatum	2
Neoechinorhynchus sp.	1
Ergasilus caeruleus	1
Capillaria catenata	1

The dace came from 15 different lakes and streams. The hosts from Ditch Creek and Kelly Warm Springs carried the cysts of *Eustrongylides* sp. *H. bakeri* was secured from a few hosts at Two Ocean and Spring Lakes. The gill flukes were taken from dace in Glade Creek and Jackson Lake.

12. Utah Chub.
Gila straria (Girard).

(Examined 670; infected 660).

**Posthodiplostomum minimum*	587
Rhabdochona cascadilla	302
**Clinostomum marginatum*	100
Glaridacris laruei and 2nd spp.	86
Neoechinorhynchus rutili	83
**Contracaecum spiculigerum*	76
**Diplostomum* sp.	62
Ergasilus caeruleus	59
Allocreadium lobatum	59
**Ichthyophthirius multifiliis*	57
**Ligula intestinalis*	30
Proteocephalus ptychocheilus	28
**Diplostomulum* sp.	13
**Neascus* sp.	11
**Eustrongylides* sp.	11
Lebouria cooperi	10
Gyrodactyloidae	5
**Diphyllobothrium* sp.	3
Capillaria catenata	3
**Hymenolepis* sp.	2
*Myxosporidia	2
**Tetracotyle* sp.	2
Triganodistomum attenuatum	1
Crepidostomum sp.	1

The mature chubs were chiefly taken from Emma Matilda and Two Ocean Lakes and the Snake River. Young Utah chubs came from most other locations where fish were collected, except the cold mountain streams. The mature cestode *P. ptychocheilus* has so far only been reported for the squawfish or chauppal, *Ptychocheilus oregonensis* (Rich), from the Bitter Root Valley at Carlton, Mont. This form was first described as a new species by Faust (1919). I have found no other published reports of the occurrence of this species. In the Jackson Hole area the distribution was limited to a few hosts from almost all of the locations where Utah chubs were collected. *Lebouria cooperi* has previously been reported for cyprinids and darters from Ohio streams and Lake Erie and more recently from Wisconsin (Bangham, unpub-

lished data). The species was described by Hunter & Bangham (1932).

The one species of Cestodaria is identified as *G. laruei* and the second is similar to *C. tetebrans*. The size and other differences have prevented positive identification as yet.

The cysts of *Hymenolepis* sp. were secured from hosts in Emma Matilda Lake.

13. Utah Silverside Minnow.

Richardsonius balteatus hydrophlox (Cope).

(Examined 479; infected 434).

**Posthodiplostomum minimum*	381
Rhabdochona cascadilla	119
**Neascus* sp.	68
**Contracaecum spiculigerum*	28
Gyrodactyloidae	28
**Clinostomum marginatum*	11
Ergasilus caeruleus	9
*Myxosporidia	8
Lebouria cooperi	7
Allocreadium lobatum	4
Capillaria catenata	3
Cestodaria	3
Neoechinorhynchus rutili	2
Proteocephalus ptychocheilus	1
**Diplostomum* sp.	1

The Utah silverside minnows came from 20 different collecting areas. The most heavily infected group came from those collected at Polecat Creek where all of 60 were infected with a total of 8 parasite species.

14. Blob, Rocky Mountain Bullhead.

Cottus semiscaber (Cope).

(Examined 50; infected 24).

**Tetracotyle* sp.	18
**Posthodiplostomum minimum*	3
***Creptotrema* sp.	2
Metabronema sp.	2
Crepidostomum sp.	1
Lebouria cooperi	1

These tiny hosts were quite free from parasites except for strigeid cysts of *Tetracotyle* and *P. minimum*. The few flukes were nearly all immature.

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